# EXHIBIT K

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

| | | |
|---|---|---|
| Methode Electronics, Inc.<br>7401 West Wilson Avenue<br>Chicago, IL 60706,<br><br>PLAINTIFF<br><br>v.<br><br>Delphi Automotive Systems LLC<br>5725 Delphi Drive<br>Troy, Michigan 48098<br><br>and<br><br>Marian, Incorporated<br>1011 E. St. Clair Street<br>Indianapolis, Indiana 46202,<br><br>DEFENDANTS. | : | Civil Action No.<br>Jury Trial Demanded |

## COMPLAINT

Plaintiff, Methode Electronics, Inc. ("Methode"), by and through its undersigned counsel, brings this complaint for patent infringement against defendants Delphi Automotive Systems LLC ("Delphi") and Marian, Inc. ("Marian"), and alleges as follows:

## PARTIES, JURISDICTION, AND VENUE

1. Methode is a Delaware corporation with its principal place of business at 7401 West Wilson Avenue, Chicago, Illinois. Methode is the assignee and owner of U.S. Patent No. 5,975,568, entitled "Sensor Pad for Controlling Airbag Deployment and Associated Support" ("the Speckhart Patent").

2. Defendant Delphi is a Delaware corporation with its principal place of business at 5725 Delphi Drive, Troy, Michigan. Delphi does business in this judicial district and throughout the state of Illinois.

3. Defendant Marian is an Indiana corporation with a principal place of business at 1011 E. St. Clair Street, Indianapolis, Indiana. Marian has a place of business in this judicial district and does business throughout the state of Illinois.

4. Jurisdiction is proper in this Court under 28 U.S.C. §§ 1331 and 1338(a), as this case arises under the patent laws of the United States, 35 U.S.C. §§ 271 and 281.

5. Venue is proper in this Court under 28 U.S.C. §§ 1391 and 1400.

## FACTS

6. Methode incorporates by reference the allegations of paragraphs 1 through 5 as though fully set forth herein.

7. In 1997, Delphi's predecessor, Delco Electronics Corporation ("Delco"), approached Methode's predecessor, American Components, Inc. ("ACI"), and requested that ACI develop a weight sensing pad suitable for use in a vehicle restraint system. Despite its attempts, Delco had been unable to develop a suitable weight sensing pad.

8. In response to Delco's request, ACI engaged Dr. Frank Speckhart, a professor at the University of Tennessee, to work with Mr. Scott Baker, Vice President of ACI, on the weight sensing pad.

9. To meet Delco's requirements, Dr. Speckhart and Mr. Baker, working together, invented a weight sensing pad with hexagonal cells formed by spot welding. Their invention is described and claimed in the Speckhart Patent.

10. The success of the Speckhart-Baker invention led Delco to enter into a multi-year agreement with ACI whereby ACI was the exclusive supplier of the weight sensing pads to Delco.

11. Subsequently, Plaintiff Methode acquired assets of ACI, including the Speckhart Patent and assets related to the weight sensing pads.

12. After Methode acquired the Speckhart Patent and assets related to the weight sensing pads in 2001, Delphi continued to purchase weight sensing pads from Methode on an exclusive basis through a second successive multi-year agreement with Methode. In this agreement, Methode provided Delphi with year over year price decreases, which applied over the term of the agreement even though material costs increased dramatically.

13. Methode's weight sensing pad is a critical component to Delphi's PODS system for complying with federal safety mandates. Since contract inception, Methode has produced and shipped in excess of 25 million weight sensing pads to Delphi.

14. In 2008, the term of the second agreement ended. Rather than negotiating in good faith with Methode, Delphi instead threatened to find a new source for the weight sensing pads. After many years of price decreases, economic factors, including material price increases and unanticipated and dramatic volume reductions, caused Methode to increase the price of the weight sensing pads.

15. During the negotiations for the 2008 agreement with its associated price increase, Defendant Delphi requested, for the first time in its seven year course of dealing with Plaintiff Methode, the tooling drawings for the weight sensing pads. When Methode requested assurances that Delphi would respect the Speckhart Patent, Delphi subsequently sued Methode in Michigan state court to obtain the tooling drawings for the weight sensing pads.

16. Defendant Delphi expressly acknowledged in its state court complaint that it demanded the tooling drawings so that Delphi could make arrangements for an alternative source for the weight sensing pads.

17. On information and belief, Delphi provided specimens and samples of the weight sensing pads and other technical information about the weight sensing pads to Marian.

18. On information and belief, Marian has used this information to manufacture infringing weight sensing pads for Delphi for the commercial purpose of entering a contract with Delphi to provide Delphi with infringing weight sensing pads.

19. Since Delphi succeeded Delco and Methode acquired ACI, Delphi has been aware of the Speckhart Patent and, on information and belief, has never sought an alternative supplier for the weight sensing pads until its relationship with Marian, as such an alternative supply agreement would result in an infringement of the Speckhart Patent.

20. On information and belief, Delphi is currently testing infringing weight sensing pads manufactured by Marian for the commercial purpose of qualifying the infringing Marian weight sensing pads in vehicle restraint systems offered for sale by Delphi.

21. On information and belief, Marian will continue to manufacture infringing weight sensing pads and will sell those infringing weight sensing pads to Delphi, and Delphi will use and sell the infringing weight sensing pads to its own customers.

## COUNT I
## PATENT INFRINGEMENT BY DELPHI

22. Methode incorporates by reference the allegations of paragraphs 1 through 21 as though fully set forth herein.

23. On November 29, 1999, the Speckhart Patent was duly and legally issued. A true and correct copy of the Speckhart Patent is appended hereto as Exhibit A.

24. The claims of the Speckhart Patent are directed, *inter alia*, to a weight sensing pad for an automobile.

25. Methode is the owner by assignment of the Speckhart Patent, its subject matter, and the rights of recovery flowing therefrom.

26. On information and belief, Delphi has manufactured and used, and continues to have manufactured and continues to use, weight sensing pads in the United States without authorization from Methode.

27. On information and belief, Delphi has offered for sale, or intends to offer for sale and sell, weight sensing pads throughout the United States without authorization from Methode.

28. On information and belief, Delphi's weight sensing pads infringe, literally or by equivalents, one or more valid and enforceable claims of the Speckhart Patent.

29. Delphi has infringed, and continues to infringe, directly or indirectly, the Speckhart Patent by, *inter alia*, practicing or inducing or contributing to others practicing one or more valid and enforceable claims of the Speckhart Patent.

30. As a direct and proximate result of Delphi's acts of infringement of the Speckhart Patent, Methode has suffered injury and damages for which it is entitled to relief, including, but not limited to, monetary damages.

31. On information and belief, Delphi has knowingly, willfully, and deliberately infringed the Speckhart Patent in conscious disregard of Methode's rights, making this case exceptional within the meaning of 35 U.S.C. § 285 and justifying treble damages pursuant to 35 U.S.C. § 284.

32. On information and belief, Delphi will continue to infringe the Speckhart Patent, causing immediate and irreparable harm unless this Court enjoins and restrains its activities.

33. On information and belief, the infringement by Delphi has deprived, and will further deprive, Methode of revenue which Methode would have made or would enjoy in the future; has injured Methode in other respects; and will cause Methode added injury and damage in the future unless Delphi is enjoined from infringing the Speckhart Patent.

## COUNT II
## PATENT INFRINGEMENT BY MARIAN

34. Methode incorporates by reference the allegations of paragraphs 1 through 33 as though fully set forth herein.

35. On information and belief, Marian has manufactured and continues to manufacture weight sensing pads in the United States without authorization from Methode.

36. On information and belief, Marian has offered for sale, and/or intends to offer for sale and sell, weight sensing pads throughout the United States without authorization from Methode.

37. On information and belief, Marian's weight sensing pads infringe, literally or by equivalents, one or more valid and enforceable claims of the Speckhart Patent.

38. Marian has infringed, and continues to infringe, directly or indirectly, the Speckhart Patent by, *inter alia*, practicing or inducing or contributing to others practicing one or more valid and enforceable claims of the Speckhart Patent.

39. As a direct and proximate result of Marian's acts of infringement of the Speckhart Patent, Methode has suffered injury and damages for which it is entitled to relief, including, but not limited to, monetary damages.

40. On information and belief, Marian has knowingly, willfully, and deliberately infringed the Speckhart Patent in conscious disregard of Methode's rights, making this case

exceptional within the meaning of 35 U.S.C. § 285 and justifying treble damages pursuant to 35 U.S.C. § 284.

41. On information and belief, Marian will continue to infringe the Speckhart Patent, causing immediate and irreparable harm unless this Court enjoins and restrains its activities.

42. On information and belief, the infringement by Marian has deprived, and will further deprive, Methode of revenue which Methode would have made or would enjoy in the future; has injured Methode in other respects; and will cause Methode added injury and damage in the future unless Marian is enjoined from infringing the Speckhart Patent.

**WHEREFORE**, Methode prays that judgment be entered in its favor and against Defendants Delphi Corporation and Marian, Inc. as follows:

A. Enter judgment for Methode that the Speckhart Patent was duly and legally issued, is valid and enforceable, and has been infringed by Delphi;

B. Enter judgment for Methode that the Speckhart Patent was duly and legally issued, is valid and enforceable, and has been infringed by Marian;

C. Enter judgment for Methode that Delphi has willfully infringed, and is willfully infringing, one or more claims of the Speckhart Patent;

D. Enter judgment for Methode that Marian has willfully infringed, and is willfully infringing, one or more claims of the Speckhart Patent;

E. Issue a preliminary injunction restraining Delphi, its directors, officers, agents, employees, successors, subsidiaries, assigns, and affiliates, and all persons acting in privy or in concert or participation with any of them from the continued infringement, direct or contributory, or active inducement of infringement by others of the Speckhart Patent;

F. Issue a preliminary injunction restraining Marian, its directors, officers, agents, employees, successors, subsidiaries, assigns, and affiliates, and all persons acting in privy or in

concert or participation with any of them from the continued infringement, direct or contributory, or active inducement of infringement by others of the Speckhart Patent;

G. Issue a permanent injunction restraining Delphi, its directors, officers, agents, employees, successors, subsidiaries, assigns, and affiliates, and all persons acting in privy or in concert or participation with any of them from the continued infringement, direct or contributory, or active inducement of infringement by others of the Speckhart Patent;

H. Issue a permanent injunction restraining Marian, its directors, officers, agents, employees, successors, subsidiaries, assigns, and affiliates, and all persons acting in privy or in concert or participation with any of them from the continued infringement, direct or contributory, or active inducement of infringement by others of the Speckhart Patent;

I. Direct Delphi to file with this Court and to serve on Methode a written report under oath setting forth in detail the manner and form in which Delphi has complied with the injunction;

J. Direct Marian to file with this Court and to serve on Methode a written report under oath setting forth in detail the manner and form in which Delphi has complied with the injunction;

K. Order Delphi to account for in written form and to pay to Methode actual damages suffered by reason of Delphi's infringement of the Speckhart Patent, including, but not limited to, monetary damages, and further order that such damages be trebled due to Delphi's deliberate, willful, and knowing conduct;

L. Order Marian to account for in written form and to pay to Methode actual damages suffered by reason of Marian's infringement of the Speckhart Patent, including, but not limited to, monetary damages, and further order that such damages be trebled due to Marian's deliberate, willful, and knowing conduct;

M. Order Delphi to pay Methode its costs, expenses, and fees, including reasonable attorneys' fees pursuant to 35 U.S.C. § 285, and pre-judgment and post-judgment interest at the maximum rate allowed by law;

N. Order Marian to pay Methode its costs, expenses, and fees, including reasonable attorneys' fees pursuant to 35 U.S.C. § 285, and pre-judgment and post-judgment interest at the maximum rate allowed by law; and

O. Grant Methode such other and further relief as the Court may deem just and proper.

## DEMAND FOR JURY TRIAL

Pursuant to Fed. R. Civ. P. 38(b), Plaintiff Methode Electronics, Inc. demands a jury trial on all issues so triable.

Dated: April 9, 2009

Respectfully submitted,

/s/ David J. Stetler

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JUDGE COAR

MAGISTRATE JUDGE BROWN

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# A

**United States Patent** [19]

**Speckhart et al.**

[11] **Patent Number: 5,975,568**

[45] **Date of Patent: Nov. 2, 1999**

[54] **SENSOR PAD FOR CONTROLLING AIRBAG DEPLOYMENT AND ASSOCIATED SUPPORT**

[75] Inventors: **Frank H. Speckhart**, Knoxville; **Robert Scott Baker**, Dandridge, both of Tenn.

[73] Assignee: **American Components, Inc.**, Dandridge, Tenn.

[21] Appl. No.: **09/146,677**

[22] Filed: **Sep. 3, 1998**

**Related U.S. Application Data**

[63] Continuation-in-part of application No. 29/085,897, Apr. 1, 1998, and application No. 09/072,833, May 5, 1998.

[51] **Int. Cl.**[6] ..... **B60R 21/32**; B60K 28/00

[52] **U.S. Cl.** ..... **280/735**; 180/273

[58] **Field of Search** ..... 180/273, 271; 280/735, 734; 297/DIG. 3, 199, 217.2; 340/667; 73/37, 700; 5/706, 707

[56] **References Cited**

U.S. PATENT DOCUMENTS

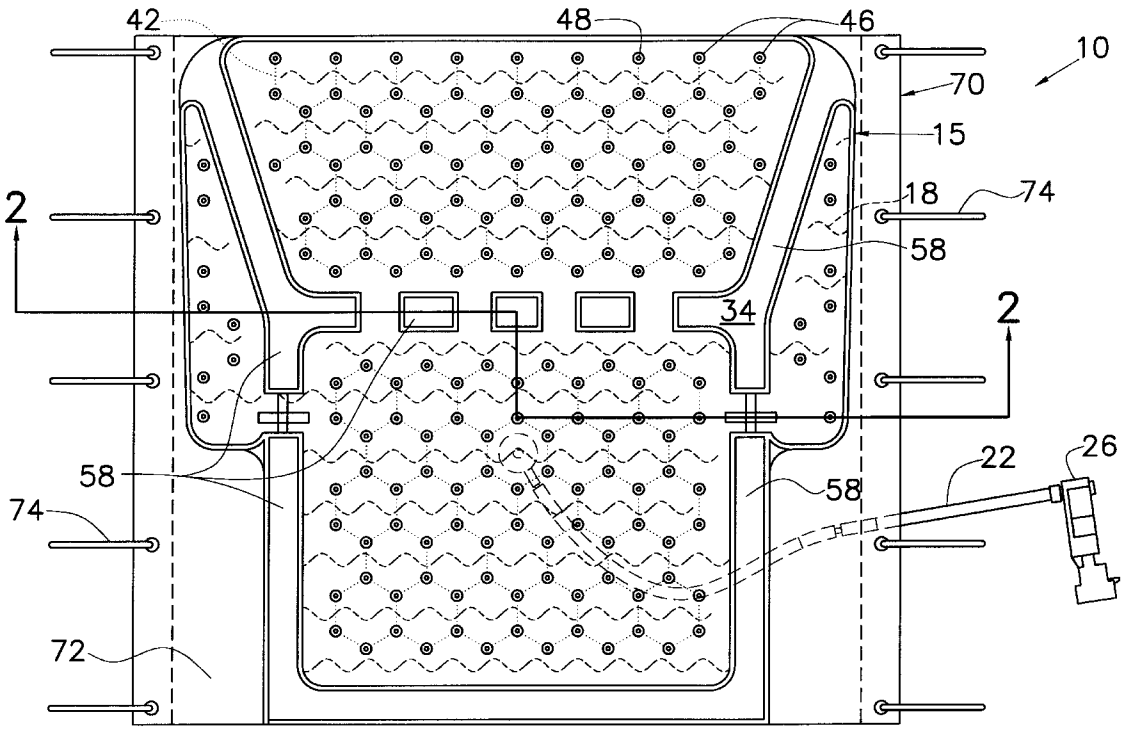
| | | | |
|---|---|---|---|
| 2,842,957 | 7/1958 | Bacon, Jr. | 73/37 |
| 4,644,597 | 2/1987 | Walker | 5/449 |
| 4,957,286 | 9/1990 | Persons, II et al. | 272/73 |
| 5,117,373 | 5/1992 | Huff | 364/550 |
| 5,427,331 | 6/1995 | Stroud | 244/122 AG |

*Primary Examiner*—Lanna Mai
*Assistant Examiner*—Faye M. Fleming
*Attorney, Agent, or Firm*—Pitts & Brittian, P.C.

[57] **ABSTRACT**

A sensor pad for controlling the deployment of an automobile airbag. Weight sensing pad **10** is used in the seat **54** of an automobile, (not illustrated), to detect the presence of an occupant on the seat. Weight sensing pad **10** is used in conjunction with the vehicle's airbag control module in order to allow deployment of the airbag, in the event of a collision, only if the seat is occupied by a person of a preselected weight. Weight sensing pad **10** is defined by a bladder member **15** having an interior volume subdivided into a plurality of individual cells **42** in fluid communication with each other and that is filled with a non-compressible fluid **18**, such as silicon or a silica gel of medium viscosity. A pressure tube **22** is in fluid communication with bladder **15** and is in further fluid communication with a pressure activated electronic transducer **26** which in turn is in electronic communication with the airbag controller **30**. When a person sits upon weight sensing pad **10**, there is a volumetric displacement of fluid **18** that provides a pressure change in the bladder member. If there is a sufficient pressure change due to the volumetric displacement of fluid to activate transducer **26**, transducer **26** sends a signal to air bag controller **30**. Electronic transducer **26** is selected to generate a signal upon detection of pressure resultant from the volumetric displacement of fluid **18** from bladder **15** expected from the average size adult of approximately one hundred pounds or heavier.

**20 Claims, 6 Drawing Sheets**



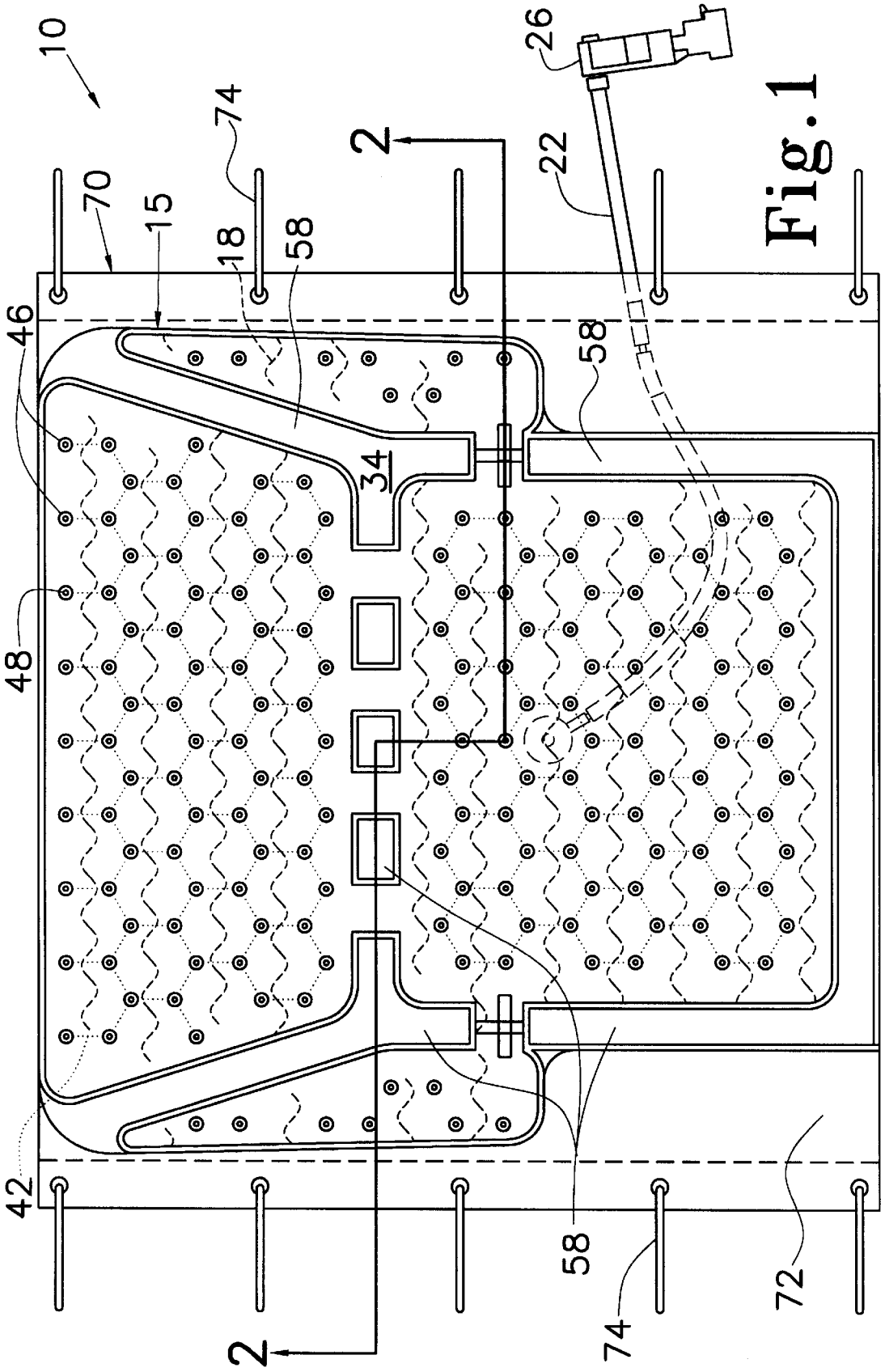



Fig. 1

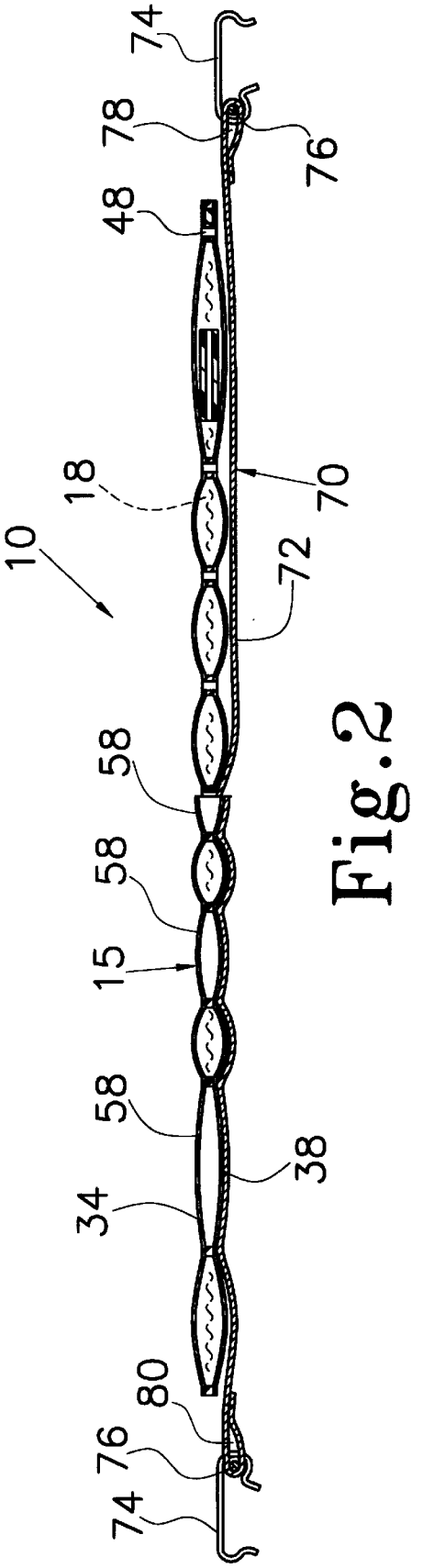

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Fig.2

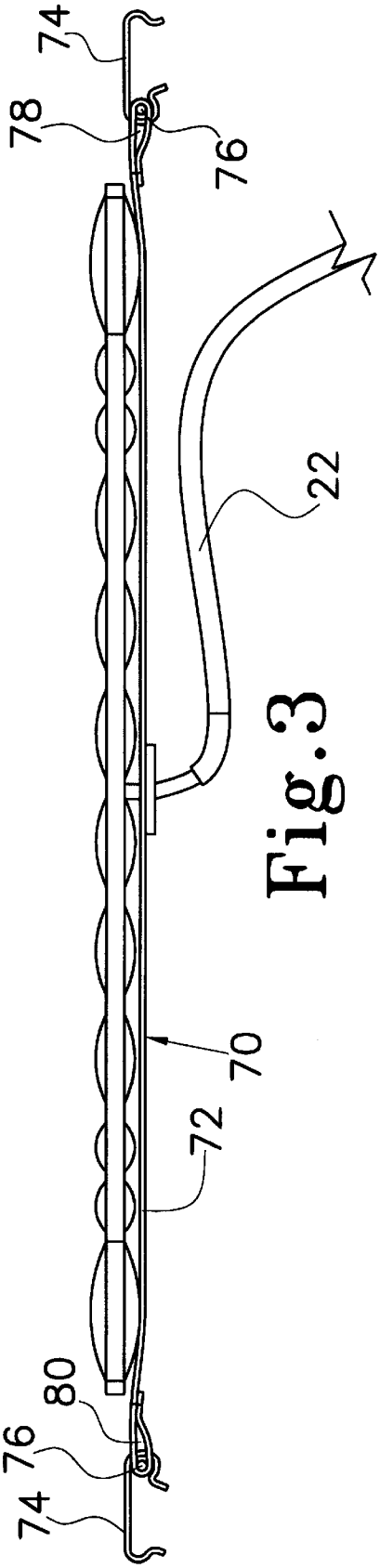
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Fig.3

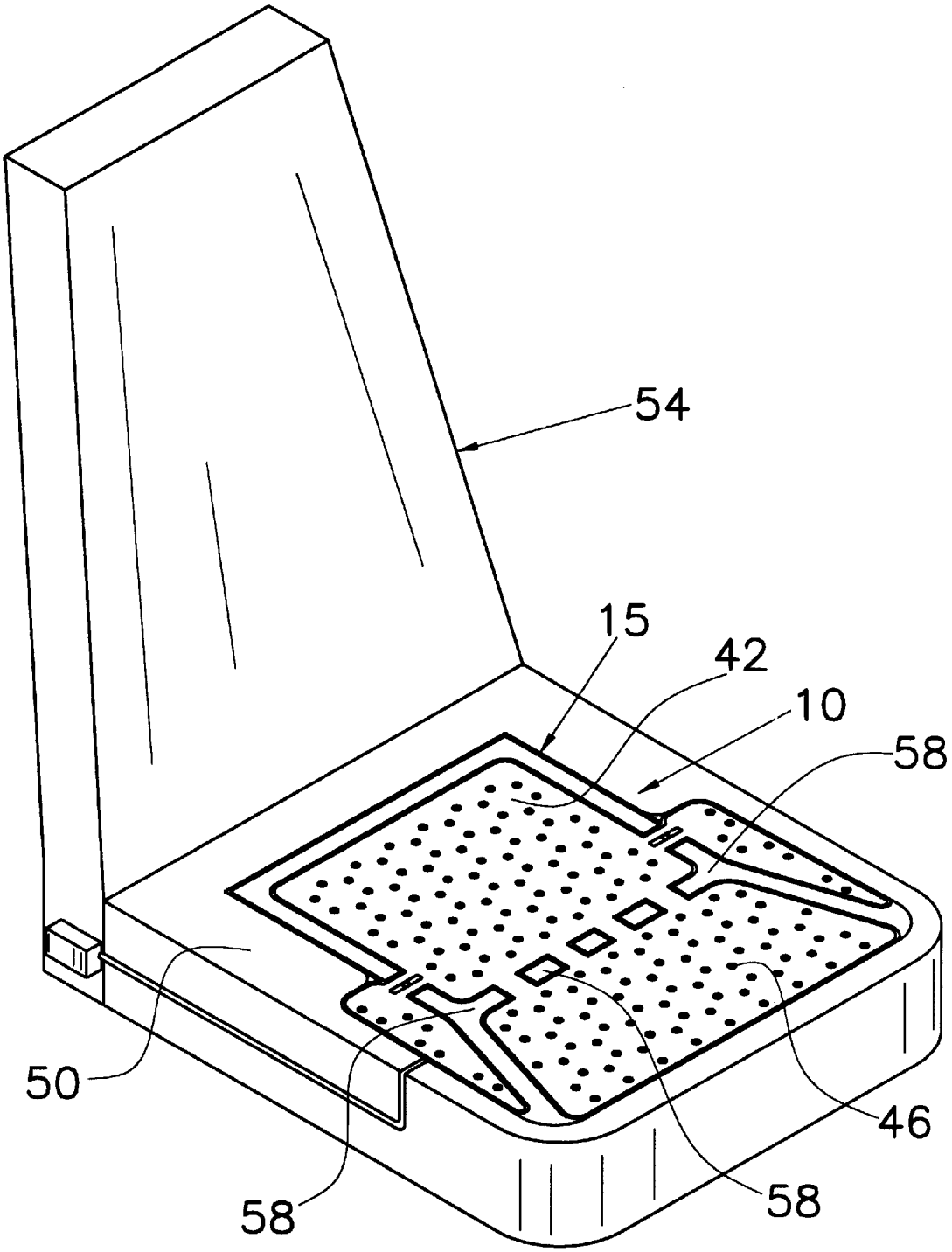


Fig.4

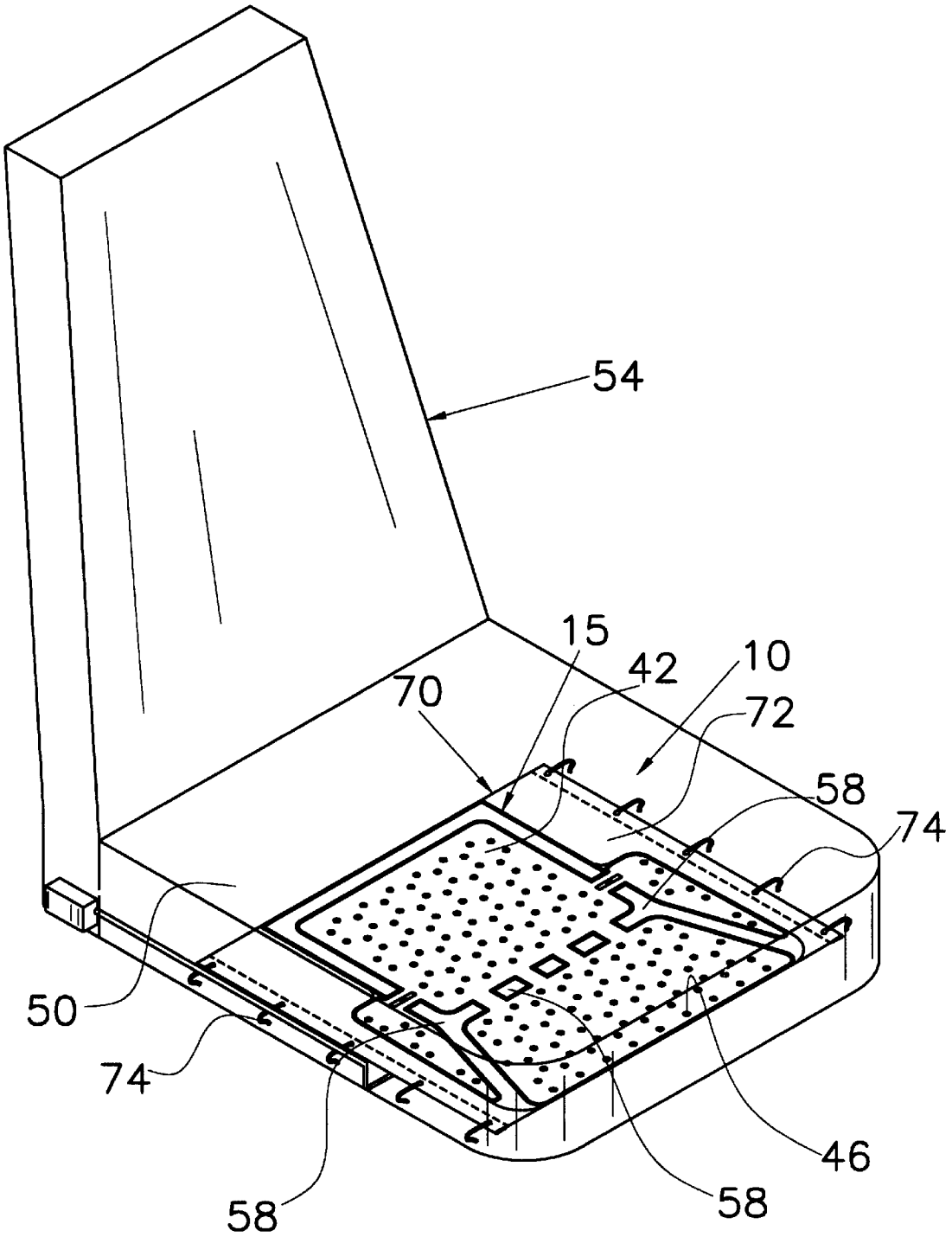


Fig.5

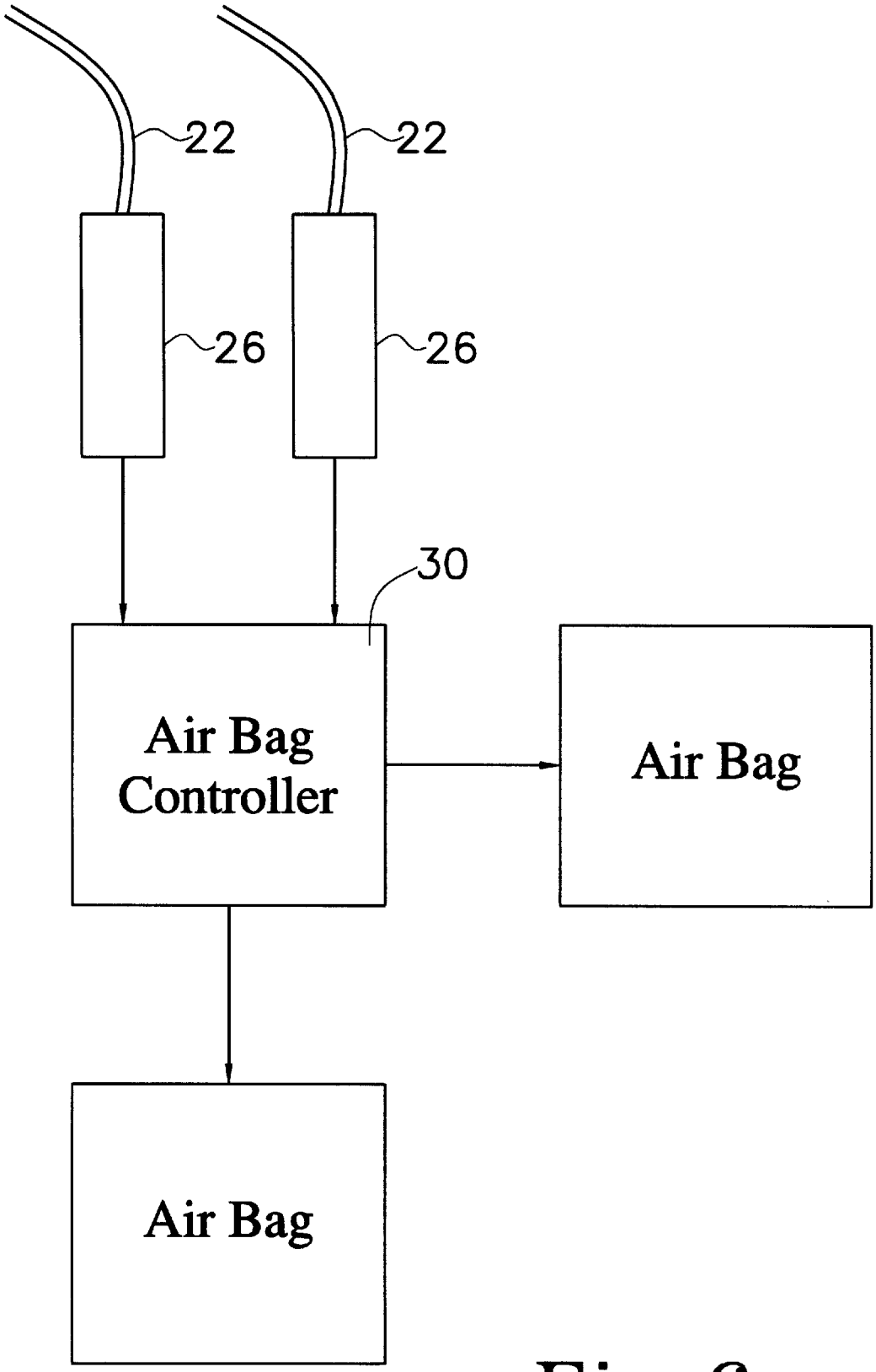


Fig.6

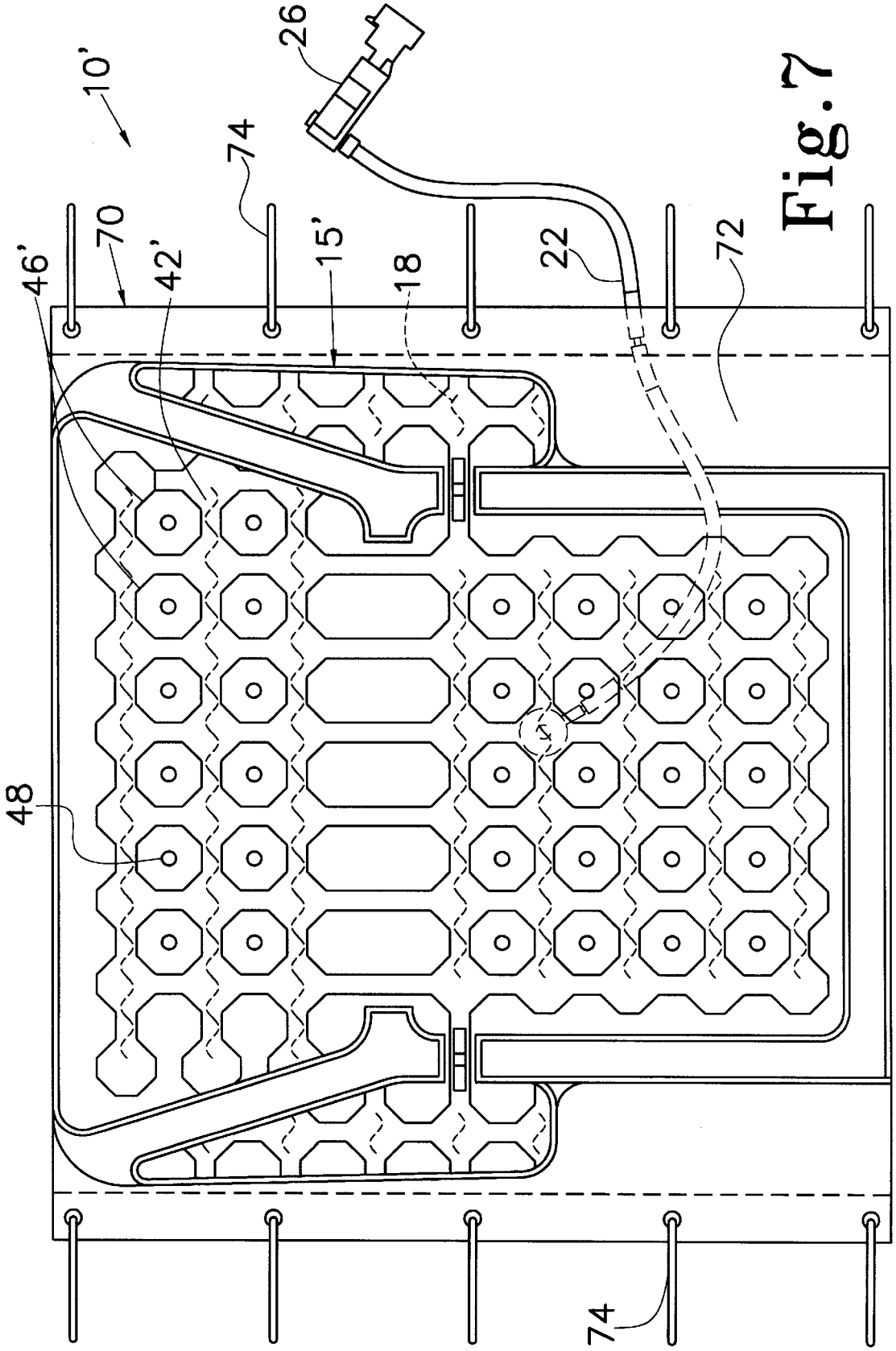


Fig. 7

# SENSOR PAD FOR CONTROLLING AIRBAG DEPLOYMENT AND ASSOCIATED SUPPORT

This application Ser. No. 09/146,677, a continuation in part discloses and claims subject matter disclosed in my earlier filed pending applications, Ser. No. 29/085,897, which was filed on Apr. 1, 1998; and Ser. No. 09/072,833, which was filed on May 5, 1998.

## TECHNICAL FIELD

This invention relates to the field of weight sensing pads. More particularly, it relates to a sensor pad, and associated sensor pad support, for detecting both the presence and weight of a passenger for controlling deployment of an automobile airbag.

## BACKGROUND ART

In recent years, airbags or self-inflating restraints, have proven to be effective in preventing injury resulting from head-on and near head-on collisions, when used correctly in conjunction with the shoulder-lap restraints. However, a small number of highly publicized incidents have highlighted a serious risk of potentially catastrophic injury to small adults, children or infants in rear-facing child-safety seats. While it is certainly advisable to place small children or infants in rear-facing child-safety seats in a rear seat, in certain types of vehicles, namely pick-up trucks, this is simply not an option. As a result, a demand has arisen for selective deployment of the automobile's self-inflating restraint. In response, certain automobile manufacturers now provide a key-switch to allow the owner/operator to choose whether or not the self-inflating restraint should be "armed" that is to say, whether the self-inflating restraint should be active and deployable in the event of a collision. However, these types of manual controls, or overrides, also carry an inherent risk. Namely the inadvertent failure to re-arm the restraint for an adult passenger, or the failure to deactivate the restraint in the event that the passenger seat is occupied by a child or safety seat. Further, the state of the art airbag deployment system does not detect whether the passenger seat is unoccupied and in the event of a collision fires the airbag, needlessly resulting in the unnecessary expense of replacing the dash and airbag mechanism.

What is missing in the art is a sensor pad that would detect the presence or absence of a person sitting in the seat and that could distinguish between an average size adult and a diminutive adult or child safety seat so as to control the deployment of an automobile self-inflating restraint, such as an airbag.

Accordingly, it is an object of the present invention to provide a sensor pad for controlling the deployment of a self-inflating restraint.

Another object of the present invention is to provide a sensor pad that is weight sensitive and that detects the presence of a person sitting in seat associated with the sensor pad and that upon detection of a person occupying the seat directs the airbag to deploy in the event of a collision.

Yet another object of the present invention is to provide a sensor pad for controlling the deployment of an automobile airbag without significantly increasing the vehicle weight or cost of manufacture.

Other objects and advantages over the prior art will become apparent to those skilled in the art upon reading the detailed description together with the drawings as described as follows.



## DISCLOSURE OF THE INVENTION

In accordance with the various features of this invention, a sensor pad for controlling the deployment of an automobile airbag is provided. In the preferred embodiment, the weight sensing pad is used in the seat of an automobile to sense the detect the presence of the seat's occupant. The volumetric displacement of the fluid within the weight sensing pad produces a pressure change and is measured with an electronic pressure transducer and is used to determine if an airbag should be deployed upon impact in a collision. In this regard, the transducer is in electronic communication with the vehicle's airbag control module. The weight sensing pad is defined by a thin, fluid-filled bladder. The bladder is preferably constructed of two identical sheets of urethane. The urethane sheets are spot welded together at a plurality of points or areas in order to form cells, in a selected geometric configuration, in fluid communication with one another. The size, geometric configuration and cross-sectional area of the spots are selected so as to maximize performance while minimizing weight. In this regard, in order to minimize the weight of the bladder, internal volume must be small in relation to the external surface area of the weight sensing pad. The bladder in the preferred embodiment is filled with a non-compressible fluid having a very low freezing point, such that there are a minimum of air, or gas, pockets within the bladder. A silicone, such as silica gel, of medium viscosity is a suitable fluid.

Volumetric displacement, under pressure, of the fluid within the bladder is dependent on a number of factors such as bladder stiffness, i.e. the ability of the urethane material to resist stretching, the zero pressure volume of the bladder, the seated area of the passenger or child safety seat, and the weight of the seated passenger or car safety seat. Bladder stiffness can be measured in units of $lb/in^5$ and can be defined to be the slope of the curve of volume change vs. pressure increase. In other words bladder stiffness=pressure change/volume change=$lb/in^2/in^3$. Bladder stiffness is a function of the physical size and shape of the individual cells as well as the thickness of the bladder material. The preferred bladder will have a high bladder stiffness. The slope of the curve is not expected to be constant. As the bladder volume increases, the slope of the curve is expected to increase.

Zero pressure volume is defined as the volume of fluid that will first cause the pressure in the bladder to increase. In order to have minimum bladder weight, the zero pressure volume should be as small as possible. Thus, the preferred bladder has a relatively small zero pressure volume and a high degree of bladder stiffness. A bladder having a large number of relatively small internal cells in fluid communication with one another and a thin-wall bladder material meets these two criteria.

In one embodiment, the bladder is configured to be placed within the seat portion of a state of the art automobile seat. While, the bladder can be supported by a seat cushion, the bladder is preferably secured to a support member that is suspended on the seat frame. The bladder includes a pressure tube connected to a pressure activated electronic transducer that is in electronic communication with the air bag control module. As will be described in more detail below, the preferred transducer is digital and sends an arming signal to the airbag control module upon detection of a preselected pressure. The bladder further includes a plurality of securement regions for securing the bladder to the seat cushion or the support member. The bladder is formed by two urethane

panels that are perimetrically sealed to each other. In the preferred embodiment, the two panels are additionally secured to one another by a plurality of relatively small, preferably circular spot welds configured to form hexagonal-like cells that are in fluid communication with each other. In an alternate embodiment, relatively large approximately octagonal spot welds are used to form small fluid cell areas, (about thirty-three percent cell area to about sixty-seven percent weld area), thus reducing the overall weight of the liquid in the bladder.

In use, an electronic transducer is selected to generate a signal upon detection of pressure resultant from the volumetric displacement of fluid inside the bladder expected from the average size adult of approximately one hundred pounds or heavier. In an alternate embodiment, an analog transducer could be utilized to generate a signal as a function of the passenger's weight. With this information the control module would fire the airbag in accordance with a preselected set of conditions. Further information regarding passenger weight could be used to determine the force at which a variable force airbag would deploy as airbag technology advances,

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a plan view of the weight sensing pad and support member of the present invention.

FIG. **2** illustrates a cross sectional view of the weight sensing pad and support member of the present invention taken along line **2**—**2** in FIG. **1**.

FIG. **3** illustrates and end view of the embodiment illustrated in FIG. **1**.

FIG. **4** illustrates a perspective view showing the weight sensing pad positioned above the cushioning in an exemplary automotive seat.

FIG. **5** illustrates a perspective view showing the weight sensing pad positioned below the cushioning in an exemplary automotive seat.

FIG. **6** illustrates a schematic view of the control of air bag deployment by the present weight sensing pad.

FIG. **7** illustrates an alternate embodiment weight sensing pad.

## BEST MODE FOR CARRYING OUT THE INVENTION

A sensor pad for controlling the deployment of an automobile airbag, constructed in accordance with the present invention, is illustrated generally as **10** in the figures. As seen in FIGS. **4** and **5**, in the preferred embodiment, weight sensing pad **10** is used in the seat **54** of an automobile, (not illustrated), to detect the presence of an occupant on the seat. Weight sensing pad **10** is used in conjunction with the vehicle's airbag control module in order to allow deployment of the airbag, in the event of a collision, only if the seat is occupied by a person of above a preselected weight. Weight sensing pad **10** is defined by a bladder member **15** having an interior volume subdivided into a plurality of individual cells **42** in fluid communication with each other and that is filled with a non-compressible fluid **18**, such as silicone or a silica gel of medium viscosity. In the preferred embodiment, fluid **18** should have a very low freezing point, preferably below the temperature of reasonably anticipated atmospheric conditions to which the typical automobile is exposed. A pressure tube **22** is in fluid communication with bladder **15** and is in further fluid communication with a pressure activated electronic transducer **26** which in turn is



in electronic communication with the airbag controller **30**. When a person sits upon a seat **54** in which a weight sensing pad **10** is mounted, there is a volumetric displacement of fluid **18** inside the bladder **15** causing the bladder **15** to change shape and consequently causes the pressure to increase which is measured by transducer **26**. If there is a sufficient volumetric displacement of fluid to cause sufficient pressure change to activate transducer **26**, transducer **26** sends a signal to air bag controller **30**. In other words, if a passenger that weighs in excess of a preselected weight is seated on a seat **54** in which a weight sensing pad **10** is mounted, a sufficient volumetric displacement will occur to activate transducer **26**.

In the preferred embodiment, bladder **15** is constructed of two preferably substantially identical sheets of urethane **34** and **38**. Volumetric displacement, under pressure, of fluid **18** within bladder **15** is dependent on a number of factors such as bladder stiffness, i.e. the ability of the urethane material to resist stretching, the zero pressure volume of bladder **15**, the seated area of the passenger and the weight of the seated passenger. Bladder stiffness can be measured in units of $lb/in^5$ and can be defined to be the slope of the curve of volume change vs. pressure increase. In other words, bladder stiffness=pressure change/volume change=$lb/in^2/in^3$. Bladder stiffness is a function of the physical size and shape of the individual cells **42** as well as the thickness of urethane sheets **34** and **38**. In general, the bladder stiffness increases when the bladder pressure increases. The preferred bladder **15** will have a high bladder stiffness. The slope of the curve is not expected to be constant. As the bladder volume increases, the slope of the curve is expected to increase.

Zero pressure volume is defined as the volume of fluid **18** that will first cause the pressure in bladder **15** to increase. In order to have minimum bladder weight, the zero pressure volume should be as small as possible. Thus, the preferred bladder **15** has a relatively small zero pressure volume and a high degree of bladder stiffness. A bladder **15** having a large number of relatively small internal cells **42** in fluid communication with one another and a thin-wall urethane sheets **34** and **38** meets these two criteria. The urethane sheets **34** and **38** are spot welded together by a plurality of spot welds **46** in order to form cells **42**, which are defined by the regions between spot welds **46**, in a selected geometric configuration, in fluid communication with one another. In the preferred embodiment, a bore hole **48** is provided through each spot weld **46** in order to provide ventilation between the passenger and the seat. The size, geometric configuration and cross-sectional area of cells **42** are selected so as to maximize performance while minimizing weight. In this regard, in order to minimize the weight of the bladder **15**, internal volume must be small in relation to the external surface area of the weight sensing pad **10**.

The bladder further includes a plurality of securement regions **58** for securing bladder **15** in the seat area **50** either to the seat cushion directly or preferably to support member **70**. In this regard, in the preferred embodiment, securement regions **58** are defined by fluid-void regions not in fluid communication with the fluid filled interior volume of bladder **15**. Support member **70** is defined by a planar piece of fabric **72** and includes at least one hook member **74** which engages the seat frame (not shown). In this regard, in the preferred embodiment, at least one rigid rod member **76** is disposed in each of two loops **78** and **80** which are in spaced relation from each other. Hooks **74** are carried by rigid rod member **76**. A seat cushion overlies sensor pad **10** and is also supported by support member **70**.

In the preferred embodiment, spot welds **46** are relatively small, circular and are selectively positioned so as to form

substantially hexagonal cells **42** that are in fluid communication with each other. While hexagonal cells are preferred, other geometrically shaped cells could be utilized. In an alternate embodiment, illustrated in FIG. **7**, relatively large octagonal spot welds **46'** are used to form small fluid cell areas **42'**, (about thirty-three percent cell area to about sixty-seven percent weld area), thus reducing the overall weight of the bladder **15'**. As above, a bore hole **48** is provided through each spot weld **46'** in order to provide ventilation between the passenger and the seat.

In use, electronic transducer **26** is selected to generate a signal upon detection of pressure resultant from the volumetric displacement of fluid **18** from bladder **15** expected from the average size adult of approximately one hundred pounds or heavier. Thus, for a small adult or child less than one hundred pounds, or if a child seat is positioned on the seat, there will be insufficient volumetric displacement to cause a pressure change to activate transducer **26** and the airbag controller will not arm the airbag to deploy in the event of a collision. In an alternate embodiment, an analog transducer could be utilized to generate a signal proportional to the passenger's weight. With this information the control module would fire the airbag in accordance with a preselected set of conditions. Further information regarding passenger weight could be used to determine the force at which a variable force airbag would deploy as airbag technology advances.

From the foregoing description, it will be recognized by those skilled in the art that a weight sensing pad for controlling deployment of an automobile airbag offering advantages over the prior art has been provided. Specifically, the sensor pad for controlling the deployment of a self-inflating restraint provides a sensor pad that is weight sensitive and that detects the presence of a person of a selected weight sitting in seat associated with the sensor pad and that upon detection of a person of a selected weight occupying the seat directs the airbag to deploy in the event of a collision without significantly increasing the vehicle weight or cost of manufacture.

While a preferred embodiment has been shown and described, it will be understood that it is not intended to limit the disclosure, but rather it is intended to cover all modifications and alternate methods falling within the spirit and the scope of the invention as defined in the appended claims.

Having thus described the aforementioned invention, I claim:

**1**. A weight sensing pad for an automobile seat, said weight sensing pad comprising:

a bladder member having a compressible interior volume defined by first and second sheets perimetrically bonded together, wherein said bladder member is subdivided into a plurality of substantially hexagonally shaped cells by a plurality of small, substantially circular regions of bonding between said first and second sheets whereby said substantially hexagonally shaped cells are in fluid communication with each other; and

a non-compressible fluid contained within said compressible interior volume of said bladder member.

**2**. The weight sensing pad of claim **1** wherein said regions of bonding are defined by spot welds.

**3**. The weight sensing pad of claim **1** wherein said fluid has a low freezing point.

**4**. The weight sensing pad of claim **1** wherein said fluid is silicon.

**5**. The weight sensing pad of claim **1** wherein said weight sensing pad further comprises a pressure activated electronic transducer in fluid communication with said bladder member and in electronic communication with an airbag control module, wherein said transducer is activated by a selected volumetric displacement of said fluid that provides a pressure change in said bladder member.



**6**. The weight sensing pad of claim **5** wherein said electronic transducer is a digital transducer.

**7**. The weight sensing pad of claim **1** wherein a bore is provided in substantially each of said plurality of small, substantially circular regions of bonding.

**8**. A weight sensing pad for controlling activation of an automobile airbag, said weight sensing pad comprising:

a bladder member having an interior volume defined by first and second sheets perimetrically bonded together, wherein said bladder member is subdivided into a plurality of substantially hexagonally shaped cells in fluid communication with each other by a plurality of small, substantially circular regions of bonding between said first and second sheets;

a fluid contained within said interior volume of said bladder member;

a pressure activated electronic transducer in fluid communication with said bladder member and in electronic communication with an airbag control module, wherein said transducer is activated by a selected volumetric displacement of said fluid that provides a pressure change in said bladder member; and

a pressure tube interconnected between and in fluid communication with said bladder member and said transducer.

**9**. The weight sensing pad of claim **8** wherein said fluid is non-compressible and has a low freezing point.

**10**. The weight sensing pad of claim **8** wherein said fluid is silicon.

**11**. The weight sensing pad of claim **8** wherein said weight sensing pad further comprises at least one securement region for facilitating securement of said weight sensing pad to an automobile seat.

**12**. The weight sensing pad of claim **8** wherein said weight sensing pad further comprises at least one support member for engaging a seat frame, said support member being defined by a planar support panel and having members for engaging a seat frame wherein said bladder member is secured to said support member.

**13**. The weight sensing pad of claim **8** wherein a bore is provided in substantially each of said plurality of small, substantially circular regions of bonding for providing ventilation through said weight sensing pad.

**14**. A weight sensing pad for controlling activation of an automobile airbag, said weight sensing pad comprising:

a bladder member having an interior volume defined by first and second sheets perimetrically bonded together, wherein said bladder member is subdivided into a plurality of substantially hexagonally shaped cells in fluid communication with each other by a plurality of small, substantially circular regions of bonding between said first and second sheets, said bladder member including at least one securement region;

at least one support member for engaging a seat frame, said support member being defined by a planar support panel secured to said at least one securement region and having members for engaging a seat frame wherein said bladder member is secured to said support member; and

a fluid contained within said interior volume of said bladder member.

**15**. The weight sensing pad of claim **14** wherein said regions of bonding are defined by spot welds.

**16**. The weight sensing pad of claim **14** wherein said fluid is non-compressible and has a low freezing point.

**17**. The weight sensing pad of claim **14** wherein said fluid is silica gel.

**18**. The weight sensing pad of claim **1** wherein a bore is provided in substantially each of said plurality of small, substantially circular regions of bonding.

**19**. A weight sensing pad for an automobile seat, said weight sensing pad comprising:

a bladder member having an interior volume defined by first and second sheets perimetrically bonded together, wherein said bladder member is subdivided into a plurality of substantially hexagonally shaped cells in fluid communication with each other by a plurality of small, substantially circular regions of bonding between said first and second sheets;

a fluid contained within said interior volume of said bladder member; and

at least one securement region for facilitating securement of said weight sensing pad to an automobile seat.



**20**. A weight sensing pad for an automobile seat, said weight sensing pad comprising:

a bladder member having an interior volume defined by first and second sheets perimetrically bonded together, wherein said bladder member is subdivided into a plurality of substantially hexagonally shaped cells in fluid communication with each other by a plurality of small, substantially circular regions of bonding between said first and second sheets;

a fluid contained within said interior volume of said bladder member; and

at least one support member for engaging a seat frame, said support member being defined by a planar support panel and having members for engaging a seat frame wherein said bladder member is secured to said support member.

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